OTS: 60-41,675 JPRS: 5930

27 October 1960

ON THE PRODUCTION AND APPLICATION OF GLASS-REINFORCED PLASTICS

By I. Trandafilova

- USSR -

Distributed by:

OFFICE OF TECHNICAL SERVICES
U. S. DEPARTMENT OF COMMERCE
WASHINGTON 25, D. C.

[redacted]

U. S. JOINT PUBLICATIONS RESEARCH SERVICE
1636 CONNECTICUT AVE., N. W.
WASHINGTON 25, D. C.

JPRS: 5930

CSO: 4789-N

ON THE PRODUCTION AND APPLICATION OF GLASS-REINFORCED PLASTICS

/Following is the translation of an article by I. Trandafilova entitled "O Proizvodstve i Primenenii Stekloplastikov" (English version above) in Plasticheskiye Massy (Plastics), No. 4, 1960, Moscow, pp 71-73./

The topic discussed at the expanded meeting of the scientific and technical council of the NIIPM on 24-26 December 1959 was the coordination of research and experimental work in the field of glass-reinforced plastics. 117 representatives from branch scientific research institutes and 43 representatives from organizations using glass-reinforced plastics were present at that meeting.

M. S. Akutin reported on the production of glass-reinforced plastics abroad and in the Soviet Union. He pointed out the need for enlarging our assortment of binders imparting special properties to glass fibers, reducing the cost of binders, switching to a new more progressive method of glass fiber production, developing new lubricants, bringing about strong bonds between polymers, carrying out the mechanization of all production processes in the course of the current seven year plan.

A. A. Peshekhonov pointed out that the strength of the glass fiber filler determines the quality of glass-reinforced plastics in his report on modern methods of production of glass-reinforced plastic articles. Investigations made at the NIIPM and the NIISV have shown that the mechanical strength of glass filaments made of non-alkali glass fibers 5 to 7 microns in diameter can be increased almost twofold; moreover their mechanical properties can be stabilized under humid conditions. The amount of glass fiber in the plastic as well as the thickness and orientation of glass fibers exert a large influence on the mechanical indices of glass-reinforced plastics. It has been shown that the minimum resin content of a glass-reinforced plastic depends on the density of the glass fiber which characterizes their minimum resin capacity. This will render possible the manufacture of high quality non-porous glass-reinforced plastics. The author described the main methods of production of glass-reinforced plastic wares which are used depending on the shape and dimensions of the molded articles.

P. Z. Li reported on the properties of a glass laminate based on phenol-resol resin and on the production of a glass laminate based on polyvinylbutyral. It has been shown that glass-reinforced resins based on phenol-resol resin prepared according to the method of vacuum molding at ordinary temperature exhibit higher strength indices than those pressed under 45 to 50 kg/cm^2. An investigation of the influence of the thermal oxidation process on the change in weight of the glass laminate has shown that long exposure to high temperature is apparently accompanied by destruction of the laminate structure due to thermal oxidation and by a decrease in its weight. It has been established that the phenol glass laminate is one of the most heat resistant and highly strong glass-reinforced plastics. The glass textolite based on polyvinylbutyral has good physico-mechanical properties. The influence of polyvinylbutyral content and other technological factors on the properties of the glass laminate have been studied.

T. M. Lukovenko reported on the properties of a glass laminate based on epoxy phenol resins. Compound epoxy phenol resin is remarkable for its heat resistance, its long life and can be set without using hardeners. A glass-reinforced plastic based on this resin has been obtained; it has good physico-mechanical properties and is heat resistant. The epoxy-phenol glass laminate may be recommended as a building material for use at high temperatures. Next T. M. Lukovenko talked about her experience in manufacturing a glass laminate based on chemically protected fabrics. Preliminary tests on the glass laminate with a 9 - 1 protective coating have shown that its strength undergoes a much smaller change than that of the uncoated glass laminate after a prolonged stay in water.

Z. V. Mikhaylova reported on the preparation process and the properties of cold-hardened unsaturated polyester resins. The PN-1 and PN-2 resins have been put into industrial production.

E. L. Kaganova reported on the preparation of unsaturated polyester resins using diphenic acid. Diphenic acid, tetrachlorophthalic and endo-methylene-tetrahydrohexachlorophthalic anhydrides impart various properties to resins: diphenic acid fosters combination with momomers; the indicated anhydrides lower the inflammability of unsaturated polyester resins. The production process of thermosetting polyester-styrol resins based on diethylene glycol, ethylene glycol, maleic anhydride and diphenic acid. The use of the latter instead of phthalic anhydride will allow for the utilization of the rich potentialities of phenanthrene and for expansion of the basic types of initial products used in the synthesis of polyester resins.

L. N. Sedov reported on the contact method of molding large size articles made of glass-reinforced plastics based on the PN-1, PN-3 and PN-4 binders and on the molding of glass mats made of satin woven glass fabrics. A method for preparing a glass laminate based on cloth impregnated with hydrophobic lubricant which strongly increase its water-resistance. These glass-reinforced plastics may be used as construction material in shipbuilding. Next L. N. Sedov talked about means of producing fireproof and low-inflammability unsaturated polyester resins. These results can be achieved by adding inorganic or chlorinated organic compounds and by chemical modification of the resins and monomers. Auto-extinguishing products have been synthesized as well. The positive influence of phosphorus-holding additions on the fireproof quality of unsaturated polyesters has been established.

V. A. Eksanov reported on the contact method of molding large size articles (boats, tubs, launches, freight motorboats) built from polyester glass-reinforced plastics. This method consists in lining the mold with glass, soaking every layer with the polyester resin, removing air and packing the material successively. The possibility of combining the glass-reinforced plastic with various materials has been under investigation: wood (keel, stem), metal (engine floor).

E. M. Demekhina reported on the technological production process of a glass-reinforced laminate based on polystyrene having good dielectric and mechanical properties. Tests performed on this material under normal atmospheric conditions during 10 minutes have shown that its specific breakdown strength is unaffected by static bending; the electric properties of the glass laminate without hydrophobic coating become worse in water.

K. N. Vlasova reported on glass-reinforced plastics obtained from polyamide resins and on a new binder, a grafted polymer, obtained as the product of a reaction between polyamide and epoxy resins. This resin is being tested as a binder in the manufacture of laminated plastics and as glue for cementing metals, glass and other materials. The production technology of laminated plastics based on capron and mixed capron-glass fabrics remarkable for their small density, their good electrical isolation and elastic properties and their resistance to wear has been developed.

V. N. Kotrelev reported on glass-reinforced plastics obtained from polycarbonates. He stressed the ever increasing importance of polycarbonates as a new kind of binder different from other thermoplastic materials by its extremely good physico-mechanical properties. The most widespread method of production is direct phosgenation of 4,4' - dioxydiphenyl - 2,2' - propane in an alkali medium.

The poor adhesion of polycarbonates to the glass filler made necessary the use of a sublayer with high adhesive properties. Epoxy resin, butvar, BF resins, polyester resin may be used as such a sublayer. Glass-reinforced plastics based on polycarbonates are remarkable for their high mechanical strength.

V. M. Gel'perina talked about glass-reinforced plastics based on silicone compounds exhibiting high heat-resistance and good dielectric properties. High temperatures and pressures are required when molding large size articles made of these materials.

Heat-resistant binders based on pure silicone resins have been obtained by hydrolysis of a mixture of methyl- and phenylchlorosilanes in a polar solvent. Several grades of high strength laminates based on modified silicone resins have been developed for the manufacture of large size building units.

I. M. Gurman reported on a new binder for glass-reinforced plastics, the epoxy-dimethylresorsinic resin obtained by combining the ED-5 and ED-6 epoxy resins with a lacquer resin. Compositions corresponding to different setting rates, which does not require the addition of any hardener, can be obtained by varying the proportions of the initial components.

N. V. Kulikov talked about experimental work on the production technology of pipes made of glass-reinforced plastics (tubular mine stands, tubes made of glass braided fabric for the gas industry, tubes for oil wells). Pressed tubes made of glass braided fabric have better strength indices than unpressed ones. It has been shown that the quality of pipes made of glass braid based on hot-hardened polyester resin are not significantly changed if the number of glass braid layers is increased 10, 20 and 60-fold. As far as thread strength is concerned, the best pipes are those with laminated insulation with glass fabric used as the filler.

N. N. Senatskiy reported on the manufacture of glass-reinforced plastic articles by the preliminary molding method. The essence of this process amounts to obtaining glass fiber blanks of the same shape as the molding by means of the Bush machine and to pressing them into moldings afterwards. The mechanical strength of the moldings can be improved by using braids made of glass. Both liquid and powdered polyester, melamine, phenol, urea formaldehyde and other resins may be used as binders. The possible manufacture of miner's helmets, gasoline and washing machine tanks by that method are under investigation.

O. M. Levitskaya talked about the production of the unsaturated polyester resins PN-1, PN-2 and PN-125 under laboratory and industrial conditions. Ebullition of the resin in vacuum helped carrying out the process at lower temperature and did away with the need for an inert gas. Glass-reinforced plastics resisting 150° have been obtained thanks to additions of triallylcyanurate, α-methylstyrene, dimetacrylic ester and ethylene glycol.

V. G. Danilova reported that production of PN-1 resin by copolymerization of maleic and phthalic anhydrides and diethylene glycol has been started at the Rubezhansk chemical combine. According to work done by the TsZL, commercial maleic anhydride obtained from industrial waste materials may be used without harming the quality of the resin; nitrogen containing up to 2 percent of oxygen can be used as an inert gas in this connection. The PN-1 resin is being tested as a binder for building materials in the production of shoots and laddles.

A. A. Pavlyukov reported on the status of work on the organization of the production of glass-reinforced plastic wares. The experiment and design bureau of the Luganskiy Council of National Economy has developed machines for producing large-size glass plates for building and a device for cutting rove. Testing gave good results with this device. Production of large size corrugated moldings of various dimensions and shapes has been going on since December 1959.

A. M. Kogan talked about the development of the technological production process of mine laddles, and scraper conveyers made of glass-reinforced plastics. One of the considerable advantages of glass-reinforced plastic articles over metallic ones is the possibility of increasing the strength of a given part by arranging fibers in the direction of the load. Paraffin emulsion is recommended as a lubricant.

In his report on glass fillers for glass-reinforced plastics M. G. Chernyak pointed out that the composition of the glass filler has a tremendous influence on the quality of glass-reinforced plastics. An aluminoborosilicate filler for glasses containing no or little boron is under development. A method for obtaining untearable fibers by continuous molding is under investigation. About 60 designs of machines manufacturing glass fibers have been created.

I. I. Ioffe talked about high-strength glass-reinforced plastics based on oriented glass fibers. He pointed out that the use of oriented glass veneer as a filler provides articles of maximum strength; materials with any arbitrary ratio of layers in any direction can thus be obtained. Wavelike packing providing lateral coupling between fibers may be used in order to increase the resistance of glass veneer in the lateral direction. A method of drying glass veneers by means of high frequency currents has been developed.

In his speech E. E. Kol'man-Ivanov described foreign equipment used in producing glass-reinforced plastics and stressed the need for building highly efficient national equipment specialized according to product types during the current Seven-Year Plan.

V. V. Audring reported on the main lines of experimental work on the creation of national equipment for the production of glass-reinforced plastic wares. Equipment for the production of the following articles has been put into use: large size glass-reinforced plastic wares by the spraying method, tubes of various diameters based on glass filaments and straps, lining material made of drawn glass-reinforced plastics. The production technology of large size articles made of glass-reinforced plastics - bath tubs, sinks, tanks, automobile bodies, cowls, cabins, parts of agricultural machines is being developed.

Ya. D. Avrasin reported on investigations on the preparation of heat-resistant glass-reinforced plastics. Heat-resistant glass-reinforced plastics have been developed from polyester and silicone modified resins; they can be used for long times at temperatures of 200-300° and for short times at 350-400°. These glass-reinforced plastics can be used in the manufacture of building and radio equipment because of their good physico-mechanical and dielectric characteristics and their easy production.

Representatives from scientific research institutes exchanged their work experience in applying glass-reinforced plastics in various sections of our national economy.

K. S. Zatsepin talked about the prospective replacement of steel pipelines by glass-reinforced plastic ones, the production technology of pipes made of glass veneer and braids with a polyester binder, about a simple continuous lining procedure for force pipes avoiding extraction of the mandrel. He also stressed the need for producing new grades of binders with a high polymerization and setting rate (1 to 2 min) and exhibiting good adhesive properties and lasting quality.

L. M. Pesin called our attention to the ever increasing importance of urea formaldehyde resins as binders.

I. K. Luk'yanchikov reported on the prospective use of glass-reinforced plastics in railroad construction, on the technology of roof building and of some items of electrical equipment made of glass-reinforced plastics used on electrified railroads.

O. V. Tamruchi reported on large scale research work done on the preparation of friction and antifriction materials made of glass-reinforced plastics intended for automobile and tractor construction. About one hundred automobile parts have been designed; the construction of an original machine for the production of antifriction materials is nearing completion.

I. F. Kanavets stressed the great importance of testing methods which make it possible to follow the dependence of the strength of a glass-reinforced plastic on its filler and binder content, to estimate the maximum adhesion index of the binder to the filler according to the degree of fabric damage in the course of a determination of the layers in a glass-reinforced plastic, to determine the degree of setting of glass-reinforced plastics, etc.

The scientific and technical council of the NIIPM outlined further measures for enlarging the assortment of raw materials for glass-reinforced plastics, developing the best compositions of glasses with no or small boron content used in the production of glass fibers with good physico-mechanical and dielectric indices, preparing efficient hydrophobic and adhesive additives and lubricants utilizing hot and cold-hardened polyester, epoxy, silicone and other binders, enlarging the assortment of glass fiber fillers. The NTS stressed the need for expanding scientific research work on glass-reinforced plastics, in particular the development of basic design principles of glass-reinforced plastics with required properties, the investigation of aging and fatigue properties of glass-reinforced plastics under various conditions, the utilization of modern techniques for molding and assembling glass-reinforced plastic units, as well as the improvement of technical information and popularization of firsthand experience in the application of glass-reinforced plastics.

1660 END